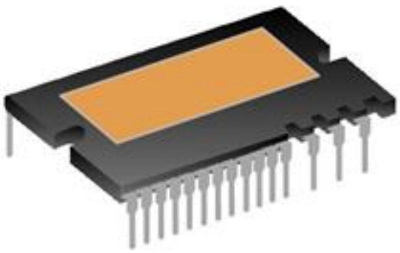
600V/30A IGBT IPM DIP-24H 三相全桥驱动智能功率模块

Features

- Integrated 6 low-loss IGBTs (600V/30A)
- Integrated high voltage gate drive circuit (HVIC)
- Built-in under voltage protection and over temperature, Over current protection and temperature output
- Insulation class 1500Vrms / min
- High reliability and thermal stability,good parameter consistency
- Built-in temperature output

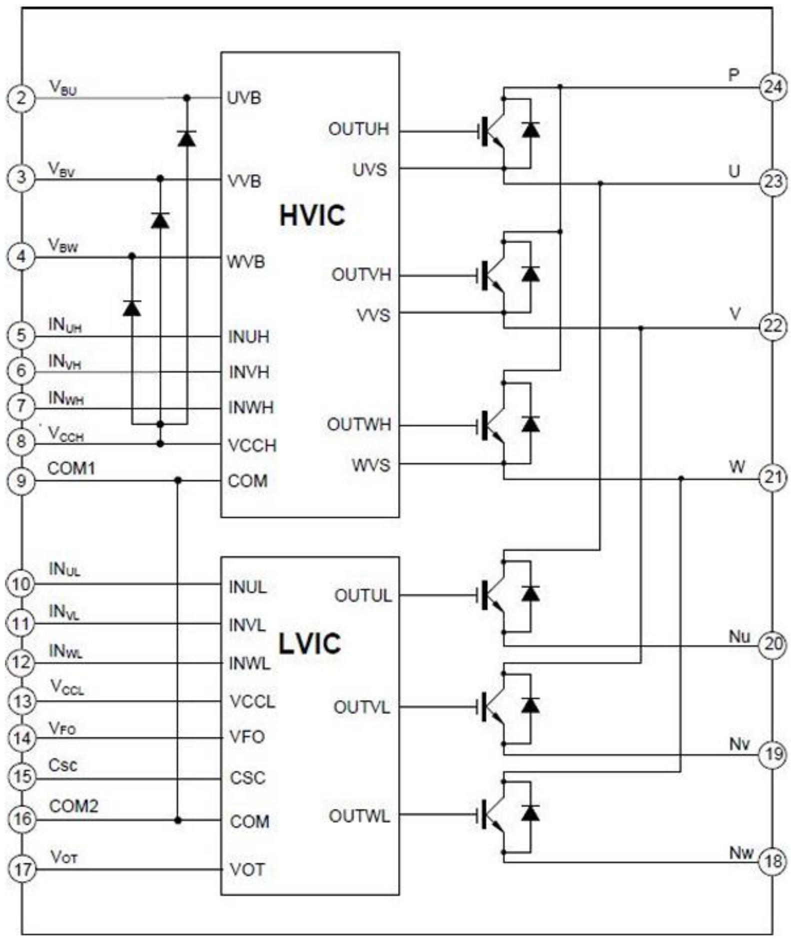


DIP-24H

Applications

- Airconditioning compressor
- Refrigerator compressor
- Low power inverters

Internal Electrical Schematic



Absolute Maximum Ratings $T_J = 25°C$, unless otherwise noted

Parameter	Symbol	Value	Unit
Inverter Section			
DC link supply voltage of P-N	V_{PN}	450	V
DC link supply voltage of P-N（surge）	$V_{PN（Surge）}$	500	V
Collector-emitter voltage	Vce	600	V
The collector continuous current of a single IGBT, TC=25°C	I_C	30	A
The peak collector current of a single IGBT, TC=25°C, pulse width <1ms	I_{CP}	60	A
Maximum power dissipation per module collector, TC=25°C， TC=25℃	P_C	83	W
Control section			
Control the supply voltage	V_{CC}	20	V
High-side control voltage	V_{BS}	20	V
Input signal voltage	V_{IN}	-0.3~VCC+0.3	V
Fault output supply voltage	V_{FO}	-0.3~VCC+0.3	V
Operating junction temperature range	T_J	-40 to 150	℃
Working shell temperature range, TJ≤150°C	T_C	-30 to 100	
Storage temperature range	T_{STG}	-40 to 125	℃
IGBT crusts thermal resistance	$R_{\theta JCB}$	1.5	℃/W
FRD crusts thermal resistance	$R_{\theta JCF}$	2.35	℃/W
Isolation test voltage (1min, RMS, f = 60Hz)	V_{ISO}	1500	Vrms

Note 1: The maximum junction temperature of the power chip is 150° C, in order to ensure that IPM can work safely, it is recommended that the average junction temperature Tj≤125° C (@Tc≤100° C)

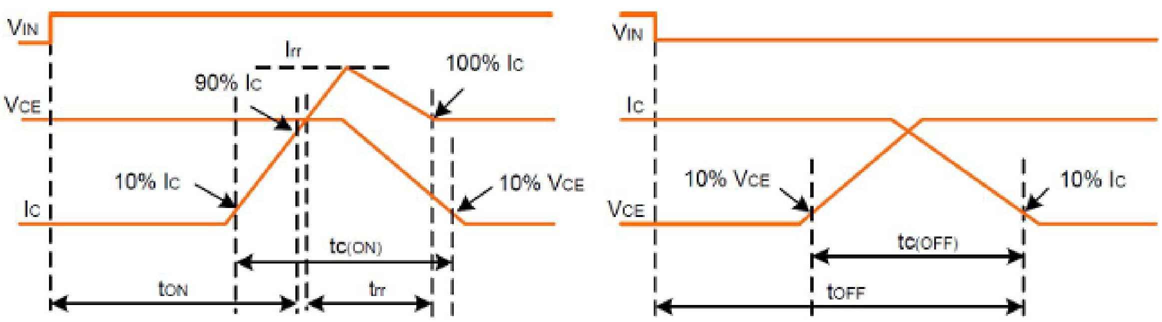
Recommended Operation Conditions $T_J = 25°C$, unless otherwise noted

Control section					
Parameter	Symbol	Min.	Typ.	Max.	Unit
Busbar voltage between PNs	VPN	-	300	400	V
Control the supply voltage	VCC	13.2	-	20	V
High-side control voltage	VBS	13.0	-	20	V
Input signal voltage	VIN	VSS	-	VCC	V
High-side gate output voltage	VHO	VS	-	VB	V
Low-side gate output voltage	VLO	VSS	-	VCC	V

Electrical Characteristics $T_J = 25°C$, unless otherwise noted

Inverter Section

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Collector-emitter saturation voltage	$V_{CE(SAT)}$	VCC=VBS=15V, VIN=5V IC=30A, TJ = 25℃	-	1.7	2.2	V
FRD forward voltage	VF	VIN=0V, IF=30A, TJ = 25℃		1.5	2.0	V
Switching time (high side)	t_{on}	VPN = 300V, VCC = VBS = 15V, IC = 30A, VIN = 0V←→ 5V, The inductive load is detailed in Figure 1	-	783	-	ns
	t_r		-	62	-	ns
	t_{off}		-	722	-	ns
	t_f		-	48	-	ns
	t_{rr}		-	110	-	ns
Switching time (low side)	t_{on}		-	946	-	ns
	t_r		-	175	-	ns
	t_{off}		-	790	-	ns
	t_f		-	48	-	ns
	t_{rr}		-	123	-	ns
Collector-emitter current	I_{CES}	VCE=600V	-	-	250	uA



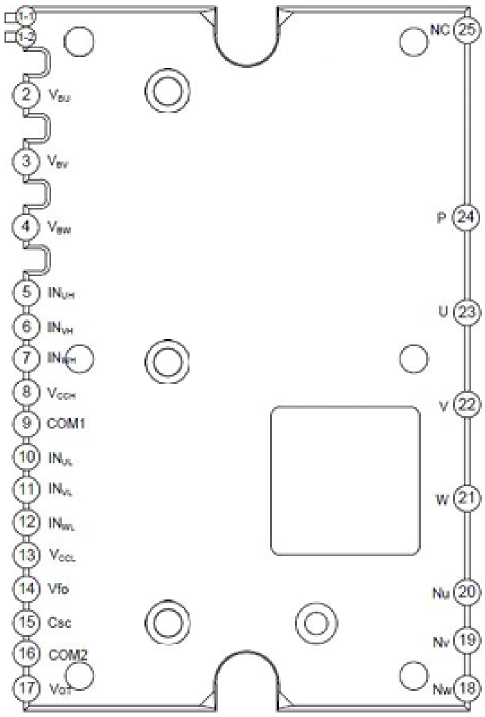
(a) Open (b) Close

Figure 1 Definition of switching time

Control section						
Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Quiescent VCC supply current	I_{QCC}	VCC=15V, VIN=0V	-	-	3.5	mA
Quiescent VBS supply current	I_{QBS}	VBS=15V, VINH=0V	-	75	-	uA
Fault output voltage	VFOH	VSC=0V, VFO pulls up 10K ΩResistor to 5V	4.9	-	-	V
	VFOL	VSC=1V, IFo=1mA	-	-	0.9	V
Fault output pulse width	t_{FO}	Fault duration	40	-	-	us
Short-circuit protection trigger voltage	$V_{SC(ref)}$	VCC=15V	0.415	0.46	0.505	V
Over-temperature protection	TSD	LVIC temperature	100	120	140	℃
Over-temperature protection hysteresis	ΔTSD	LVIC Hysteresis temperature	-	10	-	℃
Temperature output (Figure 2)	VOT	LVIC=25℃	0.88	1.13	1.39	V
		LVIC=90℃	2.63	2.77	2.91	V
Low-side undervoltage protection (Figure 5)	UVCCT	VCC senses the voltage	10	11	12	V
	UVCCR	VCC reset voltage	9	10	11	V
High-side undervoltage protection (Figure 6)	UVBST	VBS senses voltage	10	11	12	V
	UVBSR	VBS reset voltage	9	10	11	V
On-threshold voltage	VIH	Logic high	-	-	2.5	V
Shutdown threshold voltage	VIL	Logic low	0.8	-	-	V

Bootstrap diode section						
Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Forward voltage	V_F	IF=50mA, TC=25℃	-	2.5	4.0	V
Reverse recovery time	t_{rr}	IF=10mA, TC=25℃	-	50	-	ns

Pin Assignment



Pin Description

Pin Number	Pin name	Pin Description
1-1	COM	Internal common ground terminals, no connection
1-2	VCC	Internal power terminals, no connection
2	VBU	The U-phase high-side IGBT drives the floating supply voltage
3	VBV	The high-side IGBT of the V phase drives the floating supply voltage
4	VBW	The high-side IGBT of the W phase drives the floating supply voltage
5	INUH	U-phase high-side signal input
6	INVH	V-phase high-side signal input
7	INWH	High-side signal input of the W phase
8	VCCH	High side gate drive supply voltage
9	Com1	Module Commons

Pin Number	Pin name	Pin Description
10	INUL	U-phase low-side signal input
11	INVL	V-phase low-side signal input
12	INWL	W-phase low-side signal input
13	VCCL	low-side gate drives the supply voltage
14	VFO	Fault output
15	Csc	External capacitors for short-circuit current sense input and low-pass filtering
16	Com2	Module Commons
17	VOT	Temperature output
18	NW	W-phase DC negative terminal
19	NV	V-phase DC negative terminal
20	NU	U-phase DC negative terminal
21	W	W output
22	V	V output
23	U	U output
24	P	DC positive terminal
25	NC	No connection

Description of the temperature output function

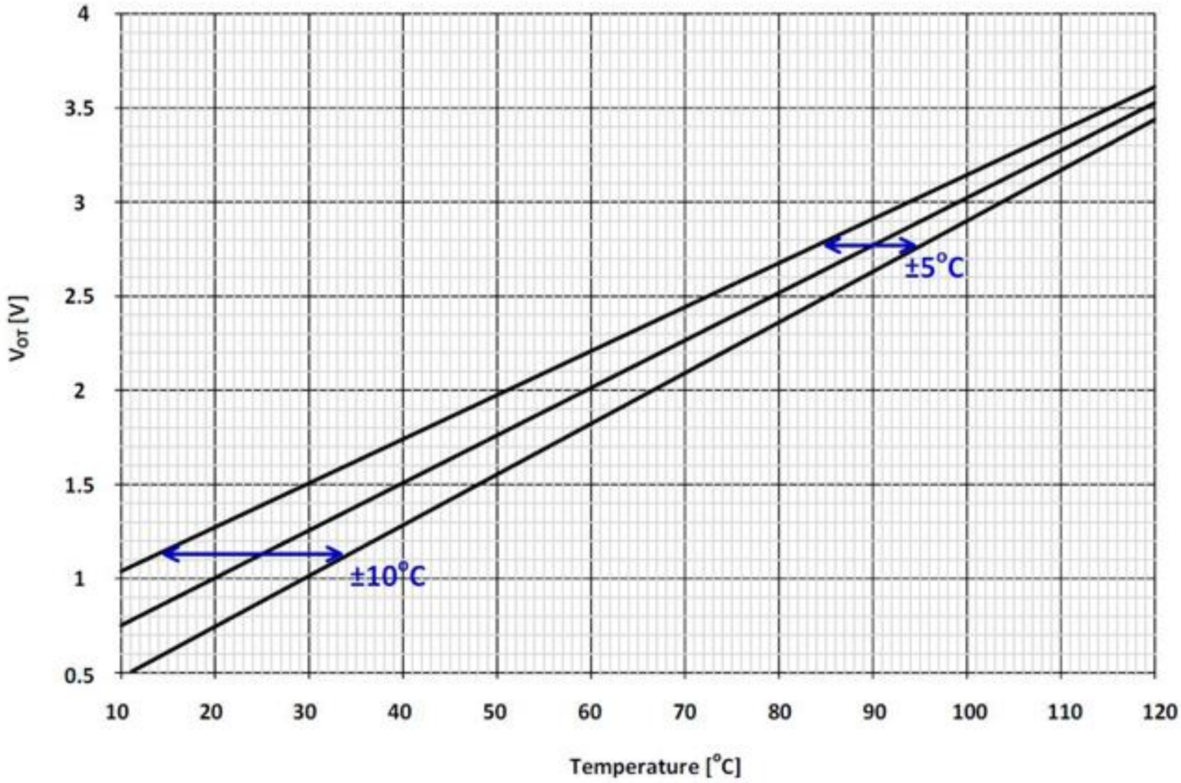


Figure 2 LVIC temperature VOT temperature characteristics

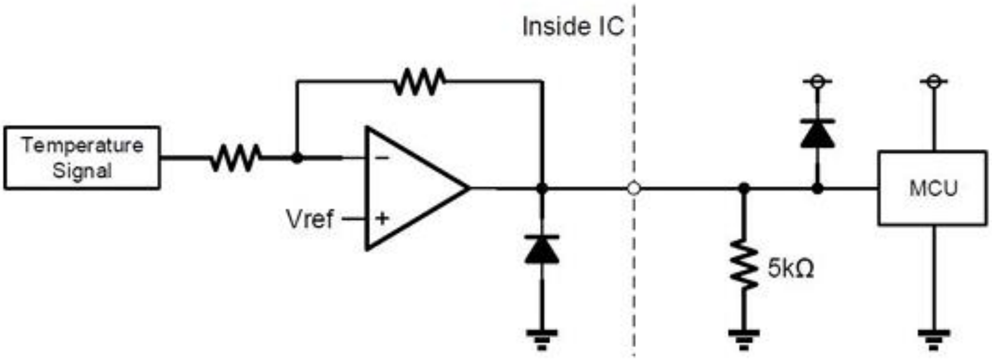


Figure 3 VOT output circuit

(1) If the temperature monitoring function is used, connect 5kΩ to the VOT pin, and ignore the internal OTP function. If the internal overtemperature shutdown function is used, keep the VOT pin on (no connection).

(2) When IPM is applied in low-voltage control (such as MCU working voltage of 3.3V), the output voltage of VOT may be greater than the control supply voltage of 3.3V in the case of a sharp rise in temperature, if the system is used for low-voltage control, it is recommended to connect a clamping diode between the control power supply and the VOT output signal to prevent overvoltage damage.

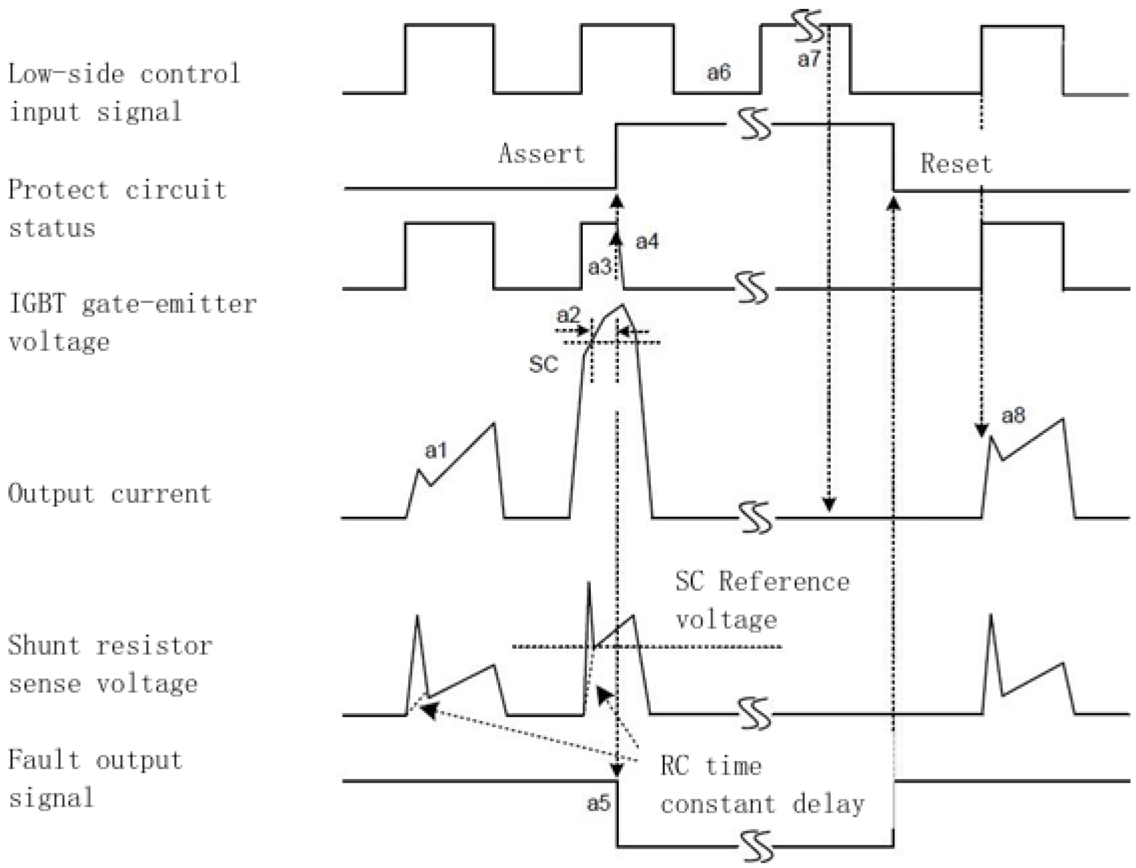


Figure 4.Short-circuit current protection (low side only)

(Includes external shunt resistor and RC connection).
a1: Normal operation: IGBT conducts and supplies current to the load.
a2: Short-circuit current detection (short-circuit triggering).
a3: All low-side IGBT gate hard interrupts.
a4: All low-side IGBTs are turned off.
a5: The fault output pin outputs a fixed pulse width signal (tFO≥ 40us).
a6: Input is "L": IGBT shutdown state.
a7: Input is "H": Although the input is "H", the IGBT is still in the off state during this time if there is a fault output signal.
a8: Normal operation: IGBT is on, current is supplied to the load.

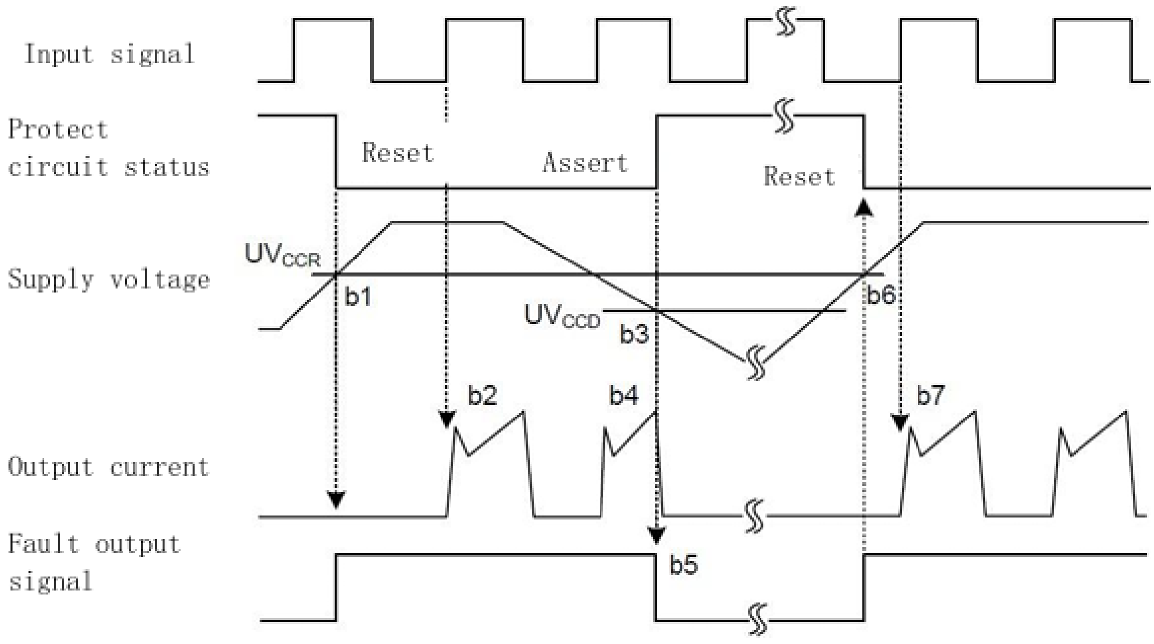


Figure 5: Undervoltage Protection (Low Side)

b1: The supply voltage rises to UVCCR and the circuit starts working when the next input waveform arrives.

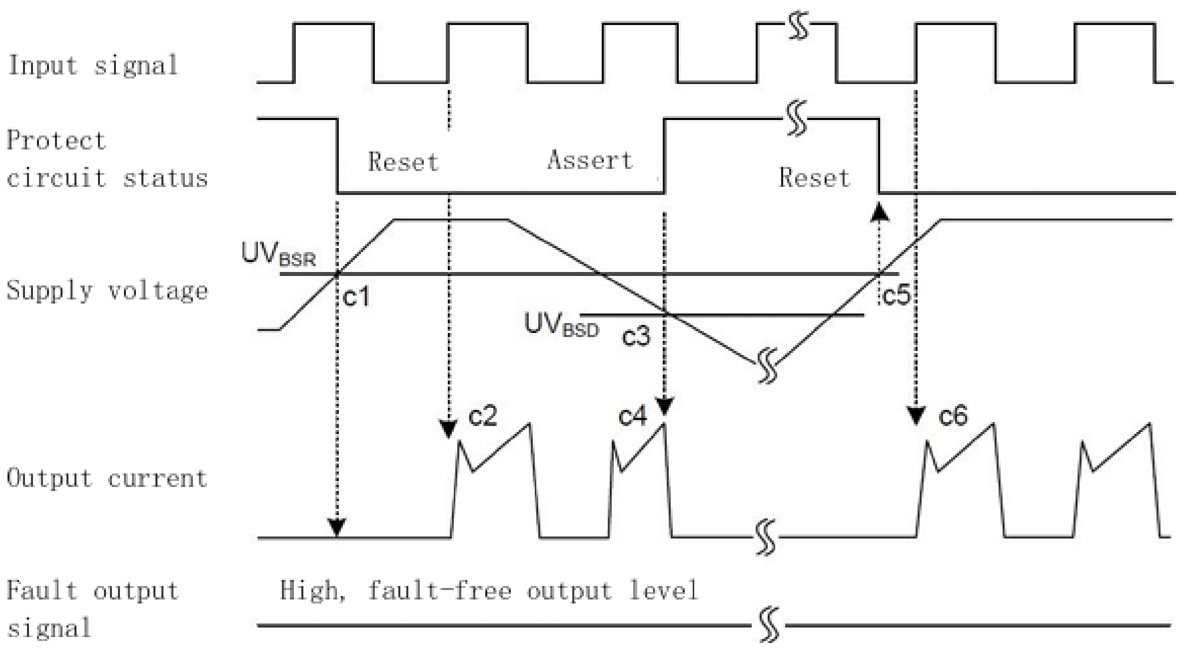
b2: Normal operation: IGBT conducts and supplies current to the load.

b3: Undervoltage detection point (UVCCT).

b4: All low-side IGBTs are turned off regardless of the signal input.

b5: The FO pin outputs a fault signal (tFO≥40us) and continuously outputs a fault signal during undervoltage. b6: Undervoltage reset point (UVCCR).

b7: normal operation: IGBT conducts and supplies current to the load.



c1: The supply voltage rises to UVBSR, and the circuit starts working when the next input signal arrives.
c2: Normal operation: IGBT conducts and supplies current to the load.
c3: Undervoltage detection point (UVBSD).
c4: IGBT is turned off regardless of signal input, but there is no fault signal output.
c5: Undervoltage reset point (UVBSR).
c6: normal operation: IGBT conducts and supplies current to the load.

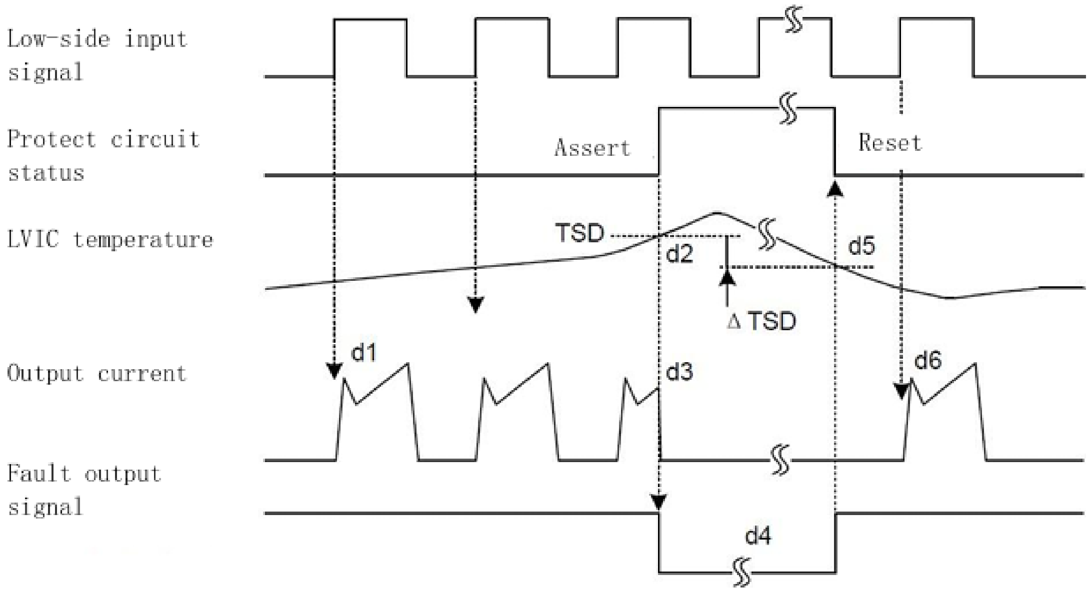


Figure 7. Overtemperature protection (low side only)
d1: Normal operation: IGBT conducts and supplies current to the load.
d2: LVIC temperature exceeds overtemperature protection trigger point (TSD).
d3: All low-side IGBTs are turned off, regardless of the signal input.
d4: Continuously outputs fault signals during overtemperature, and the minimum pulse width is 40us.
d5: LVIC temperature will reset when the temperature falls below the overtemperature protection point.
d6: When the next input signal control signal comes, the circuit enters normal working state.

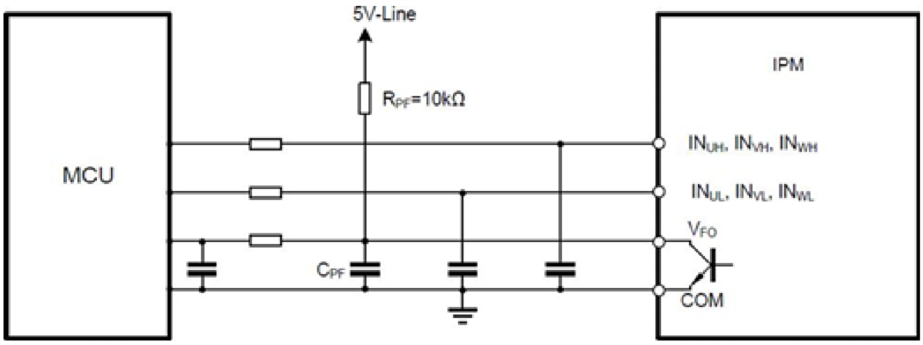
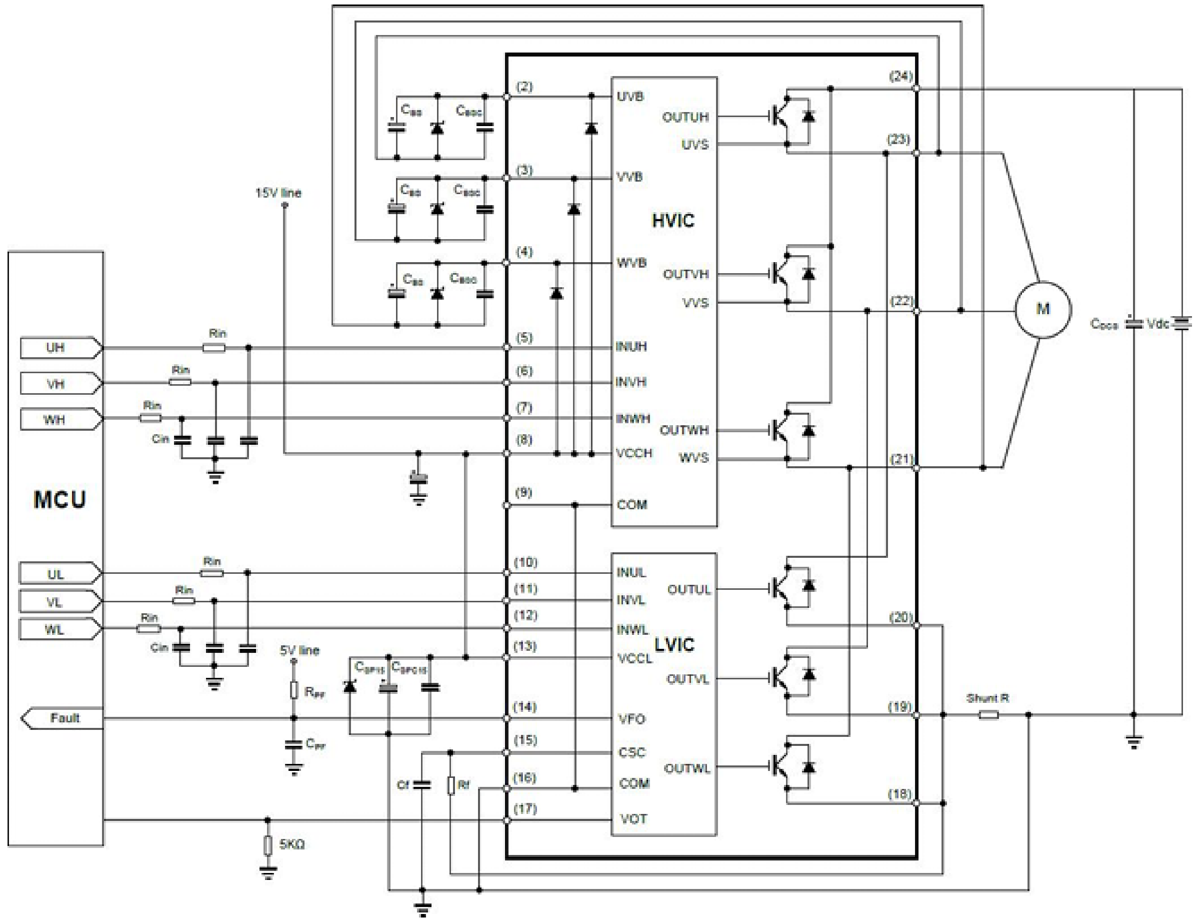


Figure 8. MCU input/output connection circuit (recommended)
Note: The RC coupling at each input should be adapted to the PWM control scheme and PCB layout. A 5K pull-down resistor is built into the IPM input signal section, so pay attention to the voltage drop at the input when using an external filter circuit.

Typical application circuit diagram



Remark:

(1) The connection of each input pin should be as short as possible, otherwise it may cause misoperation;

(2) The input signal is active high, and a 5 KΩ pull-down resistor is connected to ground at the input of each HVIC channel; In addition, an RC filter circuit can be added at the input to prevent surge noise caused by incorrect input;

(3) In order to prevent surge damage, it is recommended to add a high-frequency non-inductive flat capacitor (0.1μF ~ 0.22μF) between PNs, and the connection of the capacitor should be made Keep it as short as possible;

(4) The connection between the current sense resistor and the IPM should be as short as possible, otherwise the large surge voltage generated by the connection inductor may cause damage;

(5) The filter capacitor at the input of the 15V power supply is recommended to be at least 7 times that of the bootstrap capacitor CBS;

(6) Each external capacitor should be placed as close as possible to the IPM pin;

(7) The VFO output is open and should be pulled up to the 5V supply through the resistor so that the Ifo is 1mA;

(8) In the short-circuit protection circuit, please select RF and CSC with time constants in the range of 1.5~2 μs, and the wiring around RF and CSC should be as short as possible. The RF wiring should be close to the shunt resistor.

Package outline drawing